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March 14, 2001
VIA HAND DELIVERY

Ms. Magalie R. Salas, Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Written *Ex Parte* Submission in ET Docket No. 98-206

Dear Ms. Salas:

Pursuant to Section 1.1206 of the Commission's Rules, 47 C.F.R. Sec. 1.1206, Virtual Geosatellite LLC, through counsel, submits to the record of this proceeding the attached draft "Orbital Definition and Tolerances." Mr. Paul Locke and Mr. Tom Tycz of the International Bureau had requested that Virtual Geosatellite LLC develop this draft paper on how to define virtual geosatellite orbit assignments.

The original and one copy of this letter with attachments are submitted for inclusion in the record of the referenced proceeding.

Please contact the undersigned with any questions.

Respectfully submitted,

Raul R. Rodriguez
Counsel to Virtual Geosatellite, LLC

Attachment

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Orbital Definition and Tolerances

This paper summarizes a suggested approach to defining VGSO allocations and their tolerances.

Discussion:

Earlier papers have suggested an approach to defining VGSO assignments (see "Response to Questions regarding VGSO," 23 February 2001). This discussion attempts to apply meaningful tolerances to a VGSO assignment.

Simulation studies have shown that variations in orbital elements interact (as would be expected) to produce a net effect in satellite movement, as seen from Earth Stations. As expected, small perturbations in right ascension, argument of perigee, or mean motion alone, for example, can produce significant movement out of track and out of timing for a VGSO satellite. However, further analysis demonstrates that certain combinations of orbital perturbations can substantially counteract each other and result in relatively small net movements over much (but usually not all) of the active arcs. An example is certain combinations of perturbations to mean anomaly and argument of perigee. Therefore it does not appear feasible to specify easily measurable, two-dimensional parameters as seen from the ground at specific times (such as azimuth and elevation parameters at a specified active arc entry and/or exit time) and guarantee acceptable performance over the entire active arc in the face of perturbations to the satellite's orbit.

It might of course suffice to specify a full set of orbital parameters and place tolerances on each of them, but that approach then does not lead to easily observable, measurable, or verifiable characteristics without doing a full orbital mechanics analysis. Therefore, to avoid overly esoteric tolerance specifications while protecting against poorly performing but in-spec possibilities, the most workable approach to specifying tolerances involves placing limits on in-track and cross-track offsets applicable at all times within the active arcs. This has the desirable effect of ensuring accurate satellite placement while ignoring any perturbations that are not relevant to that objective.

Note that any tolerance specification should only concern measurement within the active arcs. At other times the satellites are quiescent, hence interference and orbital accuracy are not issues. Moreover, when quiescent, satellites may not be able to participate in ranging, telemetry or other activities designed to aid in position determination, unless that function critical to the satellite attitude is not quiescent in the inactive portion of the orbit, or at least not in the entire inactive portion of the orbit.

The following are suggested parameters for defining and assigning allocations within the VGSO operating environment. The tolerances below yield generous station-keeping boxes while ensuring tight-enough tolerances on satellite movement so as not to contribute significantly to adjacent satellite interference levels over nominal values.

Specification:

1. All assigned orbits shall conform to the following characteristics:

Mean Motion	3.000
Inclination:	63.435°, specifically that required to ensure a fixed argument of perigee in a posigrade orbit
Eccentricity:	0.630
Argument of perigee:	270° for Northern arcs (ground tracks 1a and 2a) 90° for Southern arcs (ground tracks 1b and 2b) (see 2 below)
Longitude of Apogee over Americas:	65°West (ground tracks 1a or 1b, occurring at 180° Mean Anomaly), or 125°West (ground tracks 2a or 2b, occurring at 180° Mean Anomaly), as assigned

2. Allocations may occur in any of four ground tracks:

Ground Track	Argument of Perigee	Longitude of Apogee over Americas
1a	270°	65°W
1b	90°	65°W
2a	270°	125°W
2b	90°	125°W

3. Each satellite may operate over an active arc spanning 72° to 288° of Mean Anomaly within its orbit, plus the three minutes of time preceding 72° Mean Anomaly and 3 minutes of time following 288° of Mean Anomaly. At all other times each satellite must suppress all radiation by at least 60 decibels below that authorized during operation in the active arc.

4. Each authorized satellite shall be allocated a time on the first of January 2005 at which it shall arrive at 72° Mean Anomaly in its orbit within the Americas Active Arc for its assigned Ground Track. The time of arrival at 72° Mean Anomaly on other days may be calculated by adding or subtracting an appropriate integer number of sidereal day intervals (i.e., that time necessary for the earth to rotate precisely once with respect to the stars, being approximately 23 hours and 56 minutes) to result in a time within the desired day.

5. Allowable orbital tolerances

In-Track Tolerance	No satellite shall arrive at any point within any active arc at a time more than 45 seconds removed from that predicted by the satellite's assignment, over the lifetime of the satellite.
Cross-Track Tolerance	No satellite shall move out of track by any more than 0.1 degrees as seen from any point on the earth, from that track predicted by the satellite's assignment, over the lifetime of the satellite.